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Validity of the Malnutrition Screening Tool for Older Adults at High Risk of Hospital Readmission

Author Note

This study was funded by a Queensland Nursing Council (QNC) scholarship and an Australian Postgraduate Award scholarship (APA), and was conducted as part of a PhD study of xxxxxxxxx. The sponsors had no role in the study design, execution, data analysis and interpretation, writing of the manuscript or decision to submit the paper for publication. All authors declare that they have no conflict of interest. We would like to acknowledge the assistance and support provided by all the team members of the Rehabilitation In Older adults project 2 (RIO 2). Our thanks also go to the patients and staff in the study hospitals for their time and participation.

Abstract

Malnutrition is a serious problem in older adults, particularly for those at risk of hospital readmission. The essential step in managing malnutrition is early identification using a valid nutrition screening tool. The purpose of this study was to validate the Malnutrition Screening Tool (MST) in older adults at high risk of hospital readmission. Two registered nurses administered the MST to identify malnutrition risk, and compared it to the comprehensive Subjective Global Assessment (SGA) to assess nutritional status for patients aged 65 years who had at least one risk factor for hospital readmission. The MST demonstrates substantial sensitivity, specificity and agreement with the SGA. These findings indicate that nursing staff can use the MST as a valid tool for routine screening and rescreening to identify patients at risk of malnutrition. Use of the MST may prevent hospital-acquired malnutrition for acute hospitalized older adults at high risk of readmission.

Keywords: malnutrition, nutrition screening, older adult, risk of hospital readmission, validity.

Malnutrition in older adults is a serious global problem (Kubrak & Jensen, 2007; Watterson et al., 2009) and is associated with undesirable clinical outcomes, including increased morbidity, mortality, length of hospital stay and healthcare costs (Isabel, Correia, & Waitzberg, 2003; Middleton, Nazarenko, Nivison-Smith, & Smerdely, 2001; Neumann, Miller, Daniels, & Crotty, 2005). International studies have reported a malnutrition prevalence ranging from 13% to 78% in acute hospital settings (Kubrak & Jensen, 2007). For hospitalized older adults, it ranges between 12% to 72%, depending on the different patient populations, settings and the different definitions of malnutrition used (Heersink, Brown, Dimaria-Ghalili, & Locher, 2010).

This significantly high malnutrition prevalence is of concern because older adults are more likely to experience nutritional status deterioration over the period of hospitalization caused by eating difficulties, the side-effects of medication and severity of the disease (Westergren, Unosson, Ohlsson, Lorefält, & Hallberg, 2002). Studies have shown that hospitalized older adults who are malnourished at the time of admission are likely to have increased risk of experiencing adverse events while in the hospital and following discharge, as well as increased risk of not being able to recover from malnutrition (Heersink et al., 2010; Soini, Routasalo, & Lauri, 2006). This has brought to light the importance of early and routine identification of malnutrition for older adults in acute hospital settings.

One of the potential adverse events after discharge is the need for hospital readmission. Older adults are known to have higher rates of emergency hospital readmissions in comparison to the general population (Parker, 2005; Victor, Healy, Thomas, & Seargeant, 2000), indicating a need to identify risk factors and early interventions. Previously identified risk factors for hospital readmission include multiple co-morbidities (Inouye et al., 2008), impaired functionality (Covinsky et al., 2003), age (Inouye et al., 2008), recent multiple

admissions (Lanièce et al., 2008), poor social support (Strunin, Stone, & Jack, 2007) and a history of depression (Marcantonio et al., 1999; Mitchell et al., 2010). These known risk factors enable identification of a high risk population, allowing potential early interventions to reduce readmissions.

Malnutrition is amenable to prevention by early identification and appropriate nutritional intervention (Watterson et al., 2009). Assessing nutritional status in older adults generally includes medical, nutritional and medication history, physical examinations, anthropometric data, biochemical parameters and body composition analysis (Dyck & Schumacher, 2011; Visvanathan, Newbury, & Chapman, 2004). A combination of measurements has been recommended in clinical practice to detect malnutrition (American Dietetic Association, 1994). The terms “screening” and “assessment” are used when evaluating nutritional status and they are often used interchangeably in the literature (Green & Watson, 2005). Nutrition screening, however, is considered to be a simple process to identify malnutrition risk, whereas, nutrition assessment refers to a more in-depth and comprehensive evaluation of nutritional status, including: dietary and medical history, physical assessment, anthropometric measurements, and laboratory data to confirm a diagnosis of malnutrition (American Dietetic Association, 1994).

A number of nutrition screening and assessment tools have been developed and validated for use in older adults (Stratton et al., 2004; Vellas et al., 1999). A gold standard measurement, however, has yet to be defined and, as a result, nutritional evaluation remains unrecognized and overlooked (Forster & Gariballa, 2005). Among the nutrition assessment tools, Subjective Global Assessment (SGA) (Detsky et al., 1987) is a valid and reliable tool for assessing nutritional status in older adults (Christenson, Unosson, & Ek, 2002). Nutrition assessment often requires administration by an appropriately trained clinician, such as a

dietician or registered nurse, and can be time-consuming, which means it may not be feasible for use on all hospitalized older patients. Nutrition screening, on the other hand, serves to identify patients who may be at risk of malnutrition in a quick and simple way. In the hospital, nutrition screening is usually carried out within 24-72 hours of hospital admission by registered nurses, which is an essential first step in early determination of older adults at risk of malnutrition (Charlton, 2010).

A valid, simple and easy-to-use nutritional screening tool is an important consideration for nursing staff in a busy clinical environment (Green & Watson, 2005). The Malnutrition Screening Tool (MST) is the simplest and most widely used nutritional screening tool in Australian hospitals. It has been tested for validity in inpatients and oncology outpatients in Australia (Ferguson, Capra, Bauer, & Banks, 1999; Isenring, Cross, Daniels, Kellett, & Koczwara, 2006; Neelemaat, Meijers, Kruizenga, van Ballegooijen, & van Bokhorst-de van der Schueren, 2011), but not validated specifically in frail and older adults at high risk of hospital readmission. It is important to validate a nutrition screening tool that can be used across different health care settings so that nurses can detect those who may be at nutritional risk and require appropriate nutrition intervention, particularly older adults at risk of hospital readmission. The purpose of this study, therefore, was to validate the MST by assessing the agreement and prevalence of malnutrition risk between the “MST” and “SGA” in older adults at high risk of hospital readmission.

Methods

Participants

A total of 157 hospitalised patients were recruited from September 2008 to March 2010. These patients were participants in a randomised controlled trial (RCT) (RCT,

registration number: ACTRN12608000202369), investigating the effectiveness of a multifaceted transitional care intervention, including hospital and home-based exercise and nursing care for older adults at risk of hospital readmission. All patients admitted to the medical wards of the participating hospitals who fitted the inclusion and exclusion criteria were approached and invited to participate in the study.

Inclusion criteria were based on previously identified risk factors for readmission in older adults as described above, including: Patients who were aged 65 years and over, admitted with a medical diagnosis, and had at least one of the following risk factor for readmission. They were: aged ≥ 75 years, multiple admissions in the previous 6 months; multiple co-morbidities, living alone, lacking social support, having poor self-rated health, experiencing moderate to severe functional impairment, and having a history of depression. Exclusion criteria were based on participants' ability to participate safely and understand the interventions of the main study. Patients who required home oxygen, were dependent on a wheelchair or unable to walk independently for three meters (patients independently using walking aids were not excluded), lived in a nursing home, or had a cognitive deficit or progressive neurological disease were excluded. Ethical approval for the study was obtained from the Human Research and Ethics Committees of both university and hospital.

Procedure

Potential participants were identified through medical wards within 24 hours of their admission. An information package on the study was provided and explained to potential participants and written informed consent was obtained from all participants. The eligible patients were recruited within 72 hours of their hospital admission.

Data Collection and Measures

Baseline data on demographics, health and medical history were collected from medical records. The nutritional tools were administered by two registered nurses (RN) who received training and inter-rater reliability testing conducted by an experienced dietician. The inter-rater reliability was examined (k = .82 on 9 cases) and the results showed substantial agreement between the two RNs. Two nutrition measures were conducted as follows:

Nutrition screening was performed using the MST. It consists of two questions: (1) unintentional weight loss in the last six months, (2) eating poorly because of a decreased appetite. Scoring between zero and five identifies whether participants are at risk of malnutrition (score ≥ 2) or not at risk of malnutrition (score 0, or 1) (Ferguson et al., 1999). Nutrition assessment data were collected by using the SGA, which is one of the few nutritional assessment tools that have established reliability and validity in older adults (Christenson et al., 2002). The SGA was tested in the assessment of elderly outpatients 70 years or older, and was reported to have high validity (82% of sensitivity) and inter-rater variability (77.8%) (Ek, Unosson, Larsson, Ganowiak, & Bjurulf, 1996). In addition, the SGA has been further tested for predictive validity by Duerksein et al. (2000) by comparing its ability to predict mortality from nutritional status with other measurements of nutritional status in hospitalized patients who were 70 years of age or older, which was similar to the present study. The inter-rater reliability demonstrated moderately good agreement (unweighted k = .48 ± .17) between the observers, and the results also showed that there was a significant correlation between severe malnourishment and mortality (Duerksen et al., 2000).

The SGA comprises two main areas: (1) a medical history, which assesses participants' weight change, dietary intake, gastrointestinal symptoms and functional impairment; and (2) a physical examination, which consists of assessment for loss of subcutaneous fat, muscle wasting, oedema, and ascites (Detsky et al., 1987). Participants are characterized as being well-nourished (A), moderately malnourished (B) or severely malnourished (C) (Detsky et al., 1987).

Data Analysis

Data analysis was undertaken using the Statistical Packages for the Social Sciences Version 17 (SPSS Inc., Chicago, IL, USA). Descriptive analyses were conducted for all demographic variables. The kappa statistic was used to determine the proportion of agreement between MST and SGA. The value of k varies from 0 to 1, a value of < .20 = poor, .20-.40 = fair, .41-.60 = moderate, .60-.80 = substantial, and > .81 = almost perfect (Landis & Koch, 1977). A contingency table was used to examine sensitivity (percentage of malnourished correctly identified), specificity (percentage of well-nourished correctly identified) and predictive value (likelihood that the tool correctly predicts the presence or absence of malnutrition) of the MST in detecting patients at risk of malnutrition, compared to the SGA (Gibson, 2005). Statistical significance was reported at $p < .05$ level (two-tailed).

Results

One hundred and fifty seven hospitalised patients aged between 65 to 93 years (mean 77.6 ± 6.4 years) participated in the study. Patient characteristics are shown in Table 1. The majority of participants were female (77.1%), pensioners with an income less than $30,000 per annum (79%), and had between 7 to 12 years education (33.1%). The most common diagnoses on admission were respiratory diseases in 39.5% of the cases, followed by cardiac

diseases (19.9%). The average number of risk factors for readmission was three (median = 3, range 1-8) with over half of the participants ≥ 75 years (67.5%), living alone (52.2%), and having multiple co-morbidities (95.5%). Two patients were also receiving palliative care treatment when they were admitted in addition to treatment for their acute medical condition. The median number of co-morbidities was found to be three (range 1-8), and the most commonly reported conditions were related to cardiac diseases (78.3%), respiratory diseases (53.5%) and gastrointestinal problems (44.6%).

A total of 157 participants completed the MST and 155 completed the SGA, as two participants were discharged before the data collection was completed. According to SGA, 79.4% of subjects were well-nourished and 20.6% malnourished (n = 31, including 30 moderately and 1 severely malnourished). Based on the MST, 27.4% (n = 43) of subjects screened positively as they had MST scores ≥ 2 and 72.2% (n = 114) of subjects were "not at risk" of malnutrition.

With regard to the validation of the MST, a total of 30 subjects were correctly identified as being malnourished (true positives) and 110 subjects were correctly classified as being well nourished (true negatives). Two of the 32 subjects (1.3% of 157 subjects) who were assessed as being malnourished by SGA were not detected by the MST (false negatives). Thirteen of the 123 subjects (8.4% of 155 subjects) assessed as well-nourished by SGA were identified as "risk of malnutrition" by the MST (false positives). Table 2 displays the contingency table of nutrition risk (measured by the MST) compared to nutritional status (measured by the SGA). Comparison of the MST and SGA using the kappa statistic revealed a substantial agreement, $k = .74$, $p < .001$, 95% CI [.62-.86], between the two tools.

Using SGA as the benchmark for the assessment of malnutrition, the MST achieved a high sensitivity of 94% and a specificity of 89%. The positive predictive value was .70 (the proportion of subjects who were at risk of malnutrition and were malnourished), and the negative predictive value was .98 (the proportion of subjects were not at risk of malnutrition and well nourished). Table 3 describes the numerical definitions of sensitivity, specificity, predictive value, prevalence and study results. These results indicated that the MST was a valid tool in screening for risk of malnutrition among the study population.

Discussion

The present study demonstrated the validity of MST compared with a full nutrition assessment by the SGA in older adults at high risk of hospital readmission. The MST was shown to be effective for nurses in identifying patients at risk of malnutrition when compared to the SGA, with high sensitivity (94%), specificity (89%), positive predictive value (70%) and substantial negative predictive value (98%). Additionally, the kappa statistic shows a substantial agreement, $k = .74$, $p < .001$, 95% CI [.62-.86], between these two methods.

These results are similar to previous MST validation studies conducted in the acute and oncology outpatients (Ferguson et al., 1999; Isenring et al., 2006; Neelemaat et al., 2011). The findings particularly supported the original development of the MST in 408 hospital inpatients with an average age of 57.7 ± 16.5 (19-94 years) (sensitivity = 93%, specificity = 93%, positive predictive value = .98 and negative predictive value = .73), compared with a full nutrition assessment by the SGA (Ferguson et al., 1999). Jones (2004) suggested that assessment of a tool's validity is an ongoing process, and use of the tool in a different population required new validity. There was concern whether the MST would be appropriate for older adults at high risk of readmission as it was originally developed in a younger population (57.7 ± 16.5 years). The current study, however, found that it was also

valid in an older frail population at risk of readmission. In a recent study comparing the MST with SGA in 285 residents of aged care the MST was found to be highly sensitive (84%) but have a lower specificity (66%) (positive predictive value = .65 and negative predictive value = .84), compared to the present study (Isenring, Bauer, Banks, & Gaskill, 2009). With the strong predictive values, the current study provides clear evidence that the MST performs well in older adults at the acute setting.

Other studies have used similar methods to validate other nutrition screening tools compared to the SGA (Kyle, Kossovsky, Karsegard, & Pichard, 2006; Pablo, Izaga, & Alday, 2003). The current study results, however demonstrate higher sensitivity and specificity compared to those studies. A study comparing three nutritional screening tools (nutritional risk indicator, Malnutrition Universal Screening Tool and Nutrition Risk Screening) with the SGA in 995 hospital inpatients with medical or surgical conditions attending a Swiss hospital, found that the sensitivity was in the range of 43-62% and specificity was in the range of 76-93% (Kyle et al., 2006). These results showed higher specificity than sensitivity, which indicates that these screening tools performed better in correctly identifying patients who were non-malnourished than those at risk of malnutrition (Kyle et al., 2006). Although a 100% sensitivity and specificity would be ideal for a screening tool, in reality, this is generally not achievable and hence the need to correctly classify all malnourished patients (sensitivity) takes priority over misclassifying patients who are well-nourished (specificity) (Capra, 2007).

The malnutrition prevalence was 20.6% according to the SGA in the present study, indicating one in five older hospitalized patients suffered from malnutrition. This result, however, was lower than other rates reported in the literature when the SGA was applied. A study found 30% of patients malnourished in 251 inpatients with mixed diagnoses (age 49.59

years ± 15.3) in Turkey (Sungurtekin, Sungurtekin, Hanci, & Erdem, 2004). A much higher rate of malnutrition was reported in an Argentinian study that used SGA to determine a malnutrition rate of 47.6% in 412 patients with an average age of 65 years who were admitted to the general medical units (Baccaro et al., 2007).

Similarly, a higher prevalence was reported in Australian studies, with prevalence of malnutrition ranging from 30-42% in acute hospital care settings (Banks, Ash, Bauer, & Gaskill, 2007; Lazarus & Hamlyn, 2005). The lower malnutrition prevalence of the present study may reflect that our target population were different from that of previous studies as this is the first published study that has explored the nutrition status in older adults at risk of hospital readmission. The main-study is a randomised controlled trial (RCT), which targets the population of older patients who are identified as at risk of readmission yet relatively healthy with reasonable functional ability and potentially able to live independently (Courtney et al., 2009). This group would particularly benefit from primary and secondary prevention in terms of early detection and effective interventions for malnutrition, which, in turn, may prevent any nutrition-related clinical complications.

The purpose of nutrition screening is to identify those patients who are at nutrition risk (American Dietetic Association, 1994). Early detection of malnutrition risk allows for appropriate intervention; however, it relies on validated nutrition screening tools (Isenring et al., 2009). Although many nutrition screening tools have been developed, few have been solidly validated (Jones, 2004). Examples of validated and commonly used nutrition screening tools in the Australian older adult population include the Mini Nutritional Assessment-Short Form (MNA-SF) (Rubenstein, Harker, Salva, Guigoz, & Vellas, 2001), the Malnutrition Universal Screening Tool (MUST) (Stratton et al., 2004) and the Malnutrition Screening Tool (MST) (Ferguson et al., 1999). It has been suggested that simple, accurate

and highly sensitive and specific screening tools are best in clinical practice (Ferguson et al., 1999). The simplicity and accuracy of the MST suggests it is easier to use than the other two methods as it does not require calculations such as Body Mass Index (BMI). Additionally, a quick and easy to use tool is an important consideration for nursing staff, given the time constraints and work related-pressures they face (Green & Watson, 2005). Furthermore, using the same nutrition screening approach such as MST for all patients admitted to the hospital may shed light on improving identification of malnutrition, as the nursing staff would be familiar with the method regardless of different settings. The MST is widely used in Australian teaching hospitals and has been consistently investigated and validated in more diverse samples of patients and, hence, there is the further advantage of using the MST over other screening tools.

A limitation of the study was that the samples used in the present study cannot be generalized to the older hospitalized population as a whole. People who had dementia and severe functional impairments were excluded from the study, which would potentially contribute to a higher rate of malnutrition. This validation study, however, has achieved 90% power to detect discrepancy rates of 6.5% or higher as statistically significant at the two tailed, 5% level, indicating a sufficient sample size for this study. Although results of the present study suggest that the MST is a valid nutrition screening tool, further research investigating the predictive value of MST in terms of length of stay and readmissions is recommended.

In conclusion, the MST demonstrates substantial sensitivity, specificity and agreement with the SGA, indicating it can be used as a valid tool to identify malnutrition risk. These findings are particularly meaningful for clinical practice, as nursing staff can use the MST for routine screening to identify patients at risk of malnutrition, and this may prevent hospital-acquired malnutrition for acute hospitalized older adults. Further studies are required to determine the predictive validity of the MST in terms of length of stay and readmission for acute hospitalized older adults.

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Table 1
Demographic Characteristics of the Participants

Characteristics	**Number (%)**	**(N = 157)**
Age (years), Mean ± SD[a]	77.6	(± 6.4)
Gender		
Male	36	(22.9)
Female	121	(77.1)
Income		
< $ 30, 000	124	(79.0)
$ 30 -$ 60, 000	26	(16.6)
> $ 60, 000	7	(4.50)
Education		
1< 7 years	8	(5.10)
Completed primary school	26	(16.6)
7- 12 years	52	(33.1)
Completed high school	31	(19.7)
Post secondary school	15	(9.60)
Tertiary education	25	(15.9)
Admission diagnosis		
Cardiac disease	31	(19.9)
Respiratory disease	62	(39.5)
Gastrointestinal	12	(7.60)
Renal disease	10	(6.40)
Skin problem	8	(5.10)
Orthopaedic	17	(10.8)
Other	17	(10.8)
Risk factors for readmission		
Age ≥ 75 year	106	(67.5)
Multiple recent admission	40	(25.5)
Poor social support	39	(24.8)
Functional impairment	36	(22.9)
History of depression	18	(11.5)
Poor self-rating health	73	(46.5)
Lives alone	82	(52.2)
Multiple co-morbidities	150	(95.5)
Number of risk factors, median	3	(range 1-8)
Number of co-morbidities, median	3	(range 1-8)

[a] Standard deviation.

Table 2
Contingency Table of Nutrition Risk (MST) compared to Nutritional Status (SGA)

SGA	**Malnourished**		**Well-Nourished**		**Total**
MST					
Positive (at risk)	30	(TP)	13	(FP)	n = 43
Negative (not at risk)	2	(FN)	110	(TN)	n = 112
Total	32		123		N = 155

TP: True positive; FP: False positive; FN: False Negative; TN: True Negative.

Table 3
The Numerical Definitions of Sensitivity, Specificity, Predictive Value, Prevalence and Study Results

Numerical definitions	**Study results**
Sensitivity (Se) = TP / (TP +FN)	30 / (30+2) = **.94**
Specificity (Sp) = TN / (FP + TN)	110 / (13 + 110) = **.89**
Predictive value = (TP +TN) / (TP +FP+TN+FN)	(30 + 110)/ (30 + 13 + 110 + 2) = **.90**
Positive predictive value (PPV) = TP/ (TP+FP)	30 / (30+13) = **.70**
Negative predictive value (NPV) = TN / (TN+FN)	110 / (110 + 2) = **.98**
Prevalence (P) = (TP +FN) / (TP +FP + TN + FN)	(30+2) / (30+13+110+2) = **.206**

TP: true positive; FP: false positive; FN: false negative; TN: true negative. This table was adjusted from Gibson (2005, p. 16).

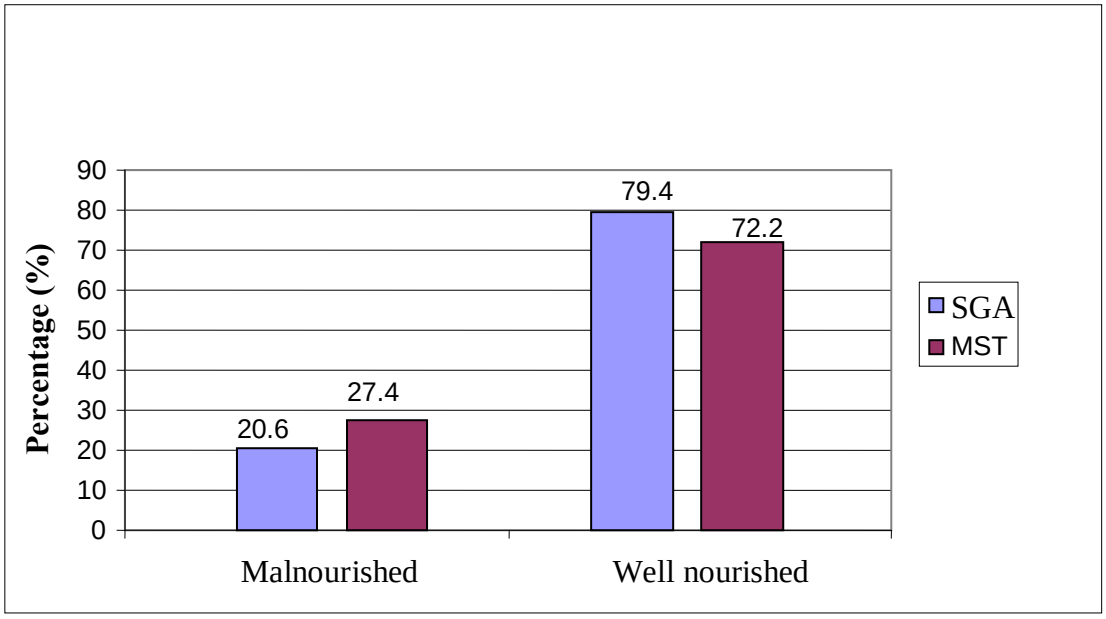

Figure 1. The Prevalence of Malnutrition in High Risk of Hospital Readmission Older Adults.

Key points of the article

1. The high prevalence of malnutrition in older adults is a significant problem and challenge for health care providers.
2. Malnutrition is amenable to prevention by early detection using a valid nutrition screening tool.
3. The Malnutrition Screening Tool (MST) is a valid nutrition screening tool, which can help nurses in identifying malnutrition risk in an effective and efficient manner.
4. The early detection of malnutrition risk provides an opportunity for nurses to facilitate appropriate nutritional management for older adults who are at risk of hospital readmission.